UCONN Physics: **Copy # ________**
Unit 7: Linear Momentum **/ 70**
Pre-Test

Directions: Use provided formula and conversion sheets provided. Do NOT write on this Pre-test if you wish to do your best on the actual test. I will not collect this pre-test, but writing on it will put you at a disadvantage for studying. Each question is worth 2 pts. You will have one class period to complete the actual test, therefore time yourself appropriately and don't spend too much time on any one question.

1) What is the SI unit of momentum?
A) N·m
B) N/s
C) N·s
D) N/m

2) When a cannon fires a cannonball, the cannon will recoil backward because the
A) energy of the cannonball and cannon is conserved.
B) momentum of the cannonball and cannon is conserved.
C) energy of the cannon is greater than the energy of the cannonball.
D) momentum of the cannon is greater than the energy of the cannonball.

3) A rubber ball and a lump of putty have equal mass. They are thrown with equal speed against a wall. The ball bounces back with nearly the same speed with which it hit. The putty sticks to the wall. Which objects experiences the greater momentum change?
A) the ball
B) the putty
C) Both experience the same momentum change.
D) cannot be determined from the information given

4) If you pitch a baseball with twice the kinetic energy you gave it in the previous pitch, the magnitude of its momentum is
A) the same.
B) 1.41 times as much.
C) doubled.
D) 4 times as much.

5) A small car meshes with a large truck in a head-on collision. Which of the following statements concerning the magnitude of the average collision force is correct?
A) The truck experiences the greater average force.
B) The small car experiences the greater average force.
C) The small car and the truck experience the same average force.
D) It is impossible to tell since the masses and velocities are not given.

6) Two equal mass balls (one red and the other blue) are dropped from the same height, and rebound off the floor. The red ball rebounds to a higher position. Which ball is subjected to the greater magnitude of impulse during its collision with the floor?
A) It's impossible to tell since the time intervals and forces are unknown.
B) Both balls were subjected to the same magnitude impulse.
C) the blue ball
D) the red ball

7) A 3.0-kg object moves to the right at 4.0 m/s. It collides head-on with a 6.0-kg object moving to the left at 2.0 m/s. Which statement is correct?
A) The total momentum both before and after the collision is 24 kg· m/s.
B) The total momentum before the collision is 24 kg·m/s, and after the collision is 0 kg·m/s.
C) The total momentum both before and after the collision is zero.
D) None of the above is true.

8) When is kinetic energy conserved?
A) in elastic collisions
B) in inelastic collisions
C) in any collision in which the objects do not stick together
D) in all collisions
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9) When a light beach ball rolling with a speed of 6.0 m/s collides with a heavy exercise ball at rest, the beach ball's speed after the collision will be, approximately,
A) 0.
B) 3.0 m/s.
C) 6.0 m/s.
D) 12 m/s.
\

10) A very heavy object moving with speed v collides head-on with a very light object at rest. The collision is elastic, and there is no friction. The heavy object barely slows down. What is the speed of the light object after the collision?
A) nearly v
B) nearly 2v
C) nearly 3v
D) nearly infinite

11) A red ball with a velocity of +3.0 m/s collides head-on with a yellow ball of equal mass moving with a velocity of -2.0 m/s. What is the velocity of the yellow ball after the collision?
A) zero
B) +3.0 m/s
C) -2.0 m/s
D) +5.0 m/s

12) In an inelastic collision, if the momentum is conserved, then which of the following statements is true about kinetic energy?
A) Kinetic energy is also conserved.
B) Kinetic energy is gained.
C) Kinetic energy is lost.
D) none of the above

13) Two objects collide and stick together. Kinetic energy
A) is definitely conserved.
B) is definitely not conserved.
C) is conserved only if the collision is elastic.
D) is conserved only if the environment is frictionless.

14) A 3.0-kg object moves to the right at 4.0 m/s. It collides in a perfectly inelastic collision with a 6.0 kg object moving to the left at 2.0 m/s. What is the total kinetic energy after the collision?
A) 72 J
B) 36 J
C) 24 J
D) 0 J

15) Consider two unequal masses, M and m. Which of the following statements is false?
A) The center of mass lies on the line joining the centers of each mass.
B) The center of mass is closer to the larger mass.
C) It is possible for the center of mass to lie within one of the objects.
D) If a uniform rod of mass m were to join the two masses, this would not alter the position of the center of mass of the system without the rod present.

16) Which of the following is a false statement?
A) For a uniform symmetric object, the center of mass is at the center of symmetry.
B) For an object on the surface of the Earth, the center of gravity and the center of mass are the same point.
C) The center of mass of an object must lie within the object.
D) The center of gravity of an object may be thought of as the "balance point."

17) Tightrope walkers walk with a long flexible rod in order to
A) increase their total weight.
B) allow both hands to hold onto something.
C) lower their center of mass.
D) move faster along the rope.

18) A ball of mass 0.10 kg is dropped from a height of 12 m. Its momentum when it strikes the ground is
A) 1.5 kg·m/s.
B) 1.8 kg·m/s.
C) 2.4 kg·m/s.
D) 4.8 kg·m/s.

19) Two identical 1500-kg cars are moving perpendicular to each other. One moves with a speed of 25 m/s due north and the other moves at 15 m/s due east. What is the total momentum of the system?
A) 4.4×10^4 kg·m/s at 31° N of E
B) 4.4×10^4 kg·m/s at 59° N of E
C) 6.0×10^4 kg·m/s at 31° N of E
D) 6.0×10^4 kg·m/s at 59° N of E

20) A 70-kg astronaut is space-walking outside the space capsule and is stationary when the tether line breaks. As a means of returning to the capsule he throws his 2.0-kg space hammer at a speed of 14 m/s away from the capsule. At what speed does the astronaut move toward the capsule?
A) 0.40 m/s
B) 1.5 m/s
C) 3.5 m/s
D) 5.0 m/s

21) A car of mass 1000 kg moves to the right along a level, straight road at a speed of 6.0 m/s. It collides directly with a stopped motorcycle of mass 200 kg. What is the total momentum after the collision?
A) zero
B) 6000 kg·m/s to the right
C) 2000 kg·m/s to the right
D) 10,000 kg·m/s to the right

22) A railroad freight car, mass 15,000 kg, is allowed to coast along a level track at a speed of 2.0 m/s. It collides and couples with a 50,000-kg second car, initially at rest and with brakes released. What is the speed of the two cars after coupling?
A) 0.46 m/s
B) 0.60 m/s
C) 1.2 m/s
D) 1.8 m/s

23) A railroad car, of mass 200 kg, rolls with negligible friction on a horizontal track with a speed of 10 m/s. A 70-kg stunt man drops straight down a distance of 4.0 m, and lands in the car. How fast will the car be moving after this happens?
A) 2.8 m/s
B) 4.7 m/s
C) 7.4 m/s
D) 10 m/s

24) Two astronauts, of masses 60 kg and 80 kg, are initially at rest in outer space. They push each other apart. What is their separation after the lighter astronaut has moved 12 m?
A) 15 m
B) 18 m
C) 21 m
D) 24 m

25) A 3.0-kg object moves to the right with a speed of 2.0 m/s. It collides in a perfectly elastic collision with a 6.0-kg object moving to the left at 1.0 m/s. What is the total kinetic energy after the collision?
A) 9.0 J
B) 6.0 J
C) 3.0 J
D) 0 J

26) A 10.0-g bullet moving at 300 m/s is fired into a 1.00-kg block at rest. The bullet emerges (the bullet does not get embedded in the block) with half of its original speed. What is the velocity of the block right after the collision?
A) 1.50 m/s
B) 2.97 m/s
C) 3.00 m/s
D) 273 m/s

27) A proton, of mass m, at rest, is struck head-on by an alpha-particle (which consists of 2 protons and 2 neutrons) moving at speed v. If the collision is completely elastic, what speed will the alpha-particle have after the collision? (Assume the neutron's mass equals the proton's mass.)
A) zero
B) 2v/3
C) 3v/5
D) 5v/3

28) A 50-gram ball moving +10 m/s collides head-on with a stationary ball of mass 100 g. The collision is elastic. What is the speed of each ball immediately after the collision?
A) -3.3 m/s and +6.7 m/s
B) +3.3 m/s and -6.7 m/s
C) -6.7 m/s and +3.3 m/s
D) +6.7 m/s and -3.3 m/s

29) A 2.0-kg mass moving to the east at a speed of 4.0 m/s collides head-on in a perfectly inelastic collision with a stationary 2.0-kg mass. How much kinetic energy is lost during this collision?
A) 16 J
B) 4.0 J
C) 8.0 J
D) zero

30) A car of mass m, traveling with a velocity v, strikes a parked station wagon, who's mass is 2m. The bumpers lock together in this head-on inelastic collision. What fraction of the initial kinetic energy is lost in this collision?
A) 1/2
B) 1/3
C) 1/4
D) 2/3

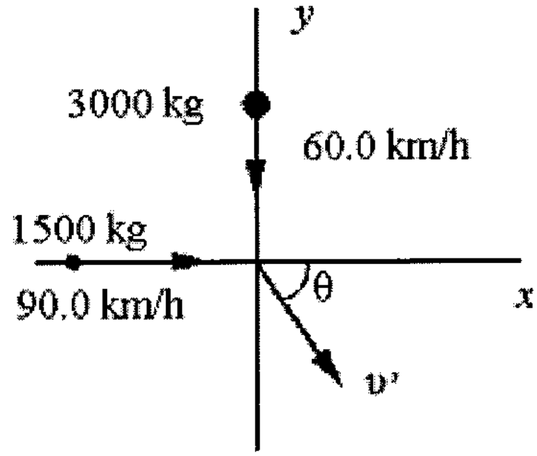


FIGURE 7-1

31) A 1500-kg car traveling at 90.0 km/h east collides with a 3000-kg car traveling at 60.0 km/h south. The two cars stick together after the collision. (See Fig. 7-1.) What is the speed of the cars after collision?
A) 8.33 m/s
B) 13.9 m/s
C) 17.4 m/s
D) 21.7 m/s

32) A 1500-kg car traveling at 90.0 km/h east collides with a 3000-kg car traveling at 60.0 km/h south. The two cars stick together after the collision. (See Fig. 7-1.) What is the direction of motion of the cars after collision?
A) 36.9° S of E
B) 36.9° E of S
C) 53.1° S of E
D) 53.1° E of S

33) A small bomb, of mass 10 kg, is moving toward the North with a velocity of 4.0 m/s. It explodes into three fragments: a 5.0-kg fragment moving west with a speed of 8.0 m/s; a 4.0-kg fragment moving east with a speed of 10 m/s; and a third fragment with a mass of 1.0 kg. What is the velocity of the third fragment? (Neglect air friction.)
A) zero
B) 40 m/s north
C) 40 m/s south
D) none of the above

34) A 3.0-kg mass is positioned at (0, 8.0), and a 1.0-kg mass is positioned at (12, 0). What are the coordinates of a 4.0-kg mass which will result in the center of mass of the system of three masses being located at the origin, (0, 0)?
A) (-3.0, -6.0)
B) (-12, -8.0)
C) (3.0, 6.0)
D) (-6.0, -3.0)

35) A handball of mass 0.10 kg, traveling horizontally at 30 m/s, strikes a wall and rebounds at 24 m/s. What is the change in momentum of the ball?
A) 0.60 kg m/s
B) 1.2 kg m/s
C) 5.4 kg m/s
D) 72 kg m/s

CHAPTER / UNIT # 7 ANSWER SHEET NAME: KEY

COPY # ______ PERIOD: ______

FORM Pre Test / DATE: ______

DIRECTIONS: Use the back side for any Bonus problems and be sure to identify the bonus area. The "Work Area" is to be used like scrap paper. If you need additional paper, raise your hand and I will provide you additional paper. Any extra scrap paper needs to be stapled to this answer sheet. GOOD LUCK!!

C	1.	A	26.
B	2.	C	27.
A	3.	A	28.
B	4.	C	29.
C	5.	D	30.
D	6.	B	31.
C	7.	C	32.
A	8.	B	33.
C	9.	A	34.
B	10.	C	35.
B	11.		36.
C	12.		37.
B	13.		38.
D	14.		39.
D	15.		40.
C	16.		41.
C	17.		42.
A	18.		43.
B	19.		44.
A	20.		45.
B	21.		46.
A	22.		47.
C	23.		48.
C	24.		49.
A	25		50.

WORK AREA

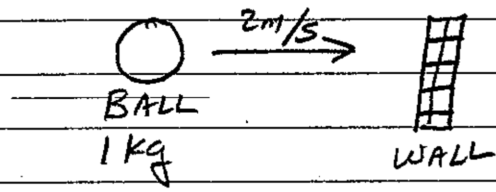
BONUS WORK ON BACK

UNIT 7: PRE-TEST GUIDE
LINEAR MOMENTUM

① UNITS OF momentum
"C" $p = m \cdot v$ $p = kg \cdot m/s$
$p = N \cdot s = [kg \cdot m/s^2 \cdot sec] = kg \cdot m/s$

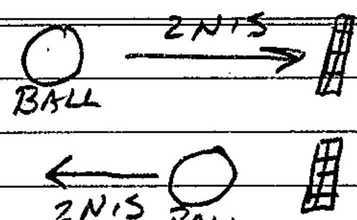
② "B" Newton's 3rd Law (action = reaction)
KE is not conserved as some energy is lost to heat and sound

③ "A" THE BALL: Reason is the Ball has momentum when moving $p = 1kg \cdot 2m/s$
$p = 2 N \cdot s$

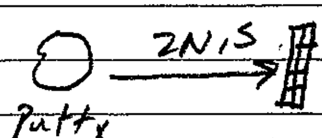


Hits wall, $\Delta P = 2N \cdot s - 0N \cdot s$
$\Delta P = 2 N \cdot s$

Ball stops, but now it bounces back, Putty does NOT bounce back.



BALL goes FROM 2N·S to 0 N·S Then FROM 0N·S Back to 2N·S ∴ BALL UNDERGOES A Total Change of 4N·S.



Putty does NOT bounce ∴ goes FROM 2N·S to 0 N·S
Total For Putty = 2N·S Change.

(4) "B" 1^{st} Pitch = KE
2^{nd} Pitch = 2KE

Assume mass of Ball is the same for both Pitches.

1^{st} Pitch | 2^{nd} Pitch

$$\tfrac{1}{2} m_1 V_1^2 = 2\left(\tfrac{1}{2} m_1 V_2^2\right)$$

$$V_1^2 = 2V_2^2$$

$$V_1 = \sqrt{2V_2^2}$$

$$V_1 = 1.41\,V_2 \qquad V_2 = \frac{V_1}{1.41}$$

$$P_1 = m_1 V_1 \qquad P_2 = m_1 V_2$$

IF $V_1 = V_2$ momentum's would be the same since mass is the same <u>BUT</u> V_2 is 1.41 times smaller than V_1 ∴ the second Pitch would have 1.41 times smaller momentum since momentum and Velocity are directly related.

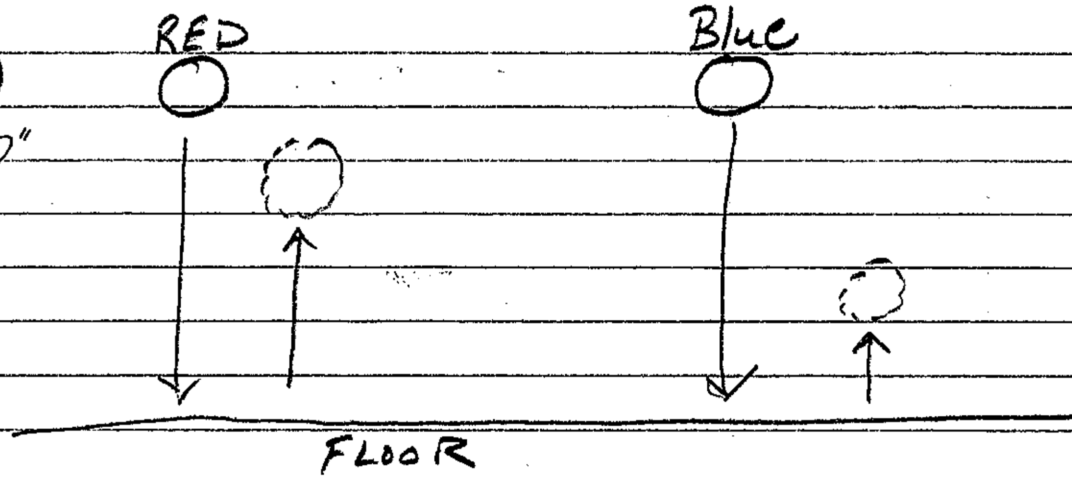
(5) "C" The collision is INELASTIC ∴ The Change in momentum of this system is zero (0). $\Delta p = F \cdot t$

$$\therefore \Delta P_{CAR} = \Delta P_{Truck}$$

$$F \cdot t = F \cdot t$$

The time of Collision is the SAME FOR Both ∴ Force is the Same.

(6) "D"



Impulse = Change in momentum
$F \cdot t = m \cdot \Delta V$

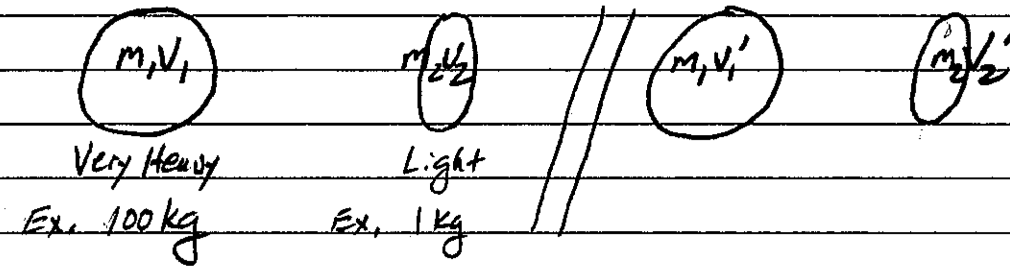
The one the rebounds higher has a Larger Change in Velocity ∴ This has a Large Impulse.

(7) "C" "C" obeys the Law of Conservation of momentum

(8) "A" Per definition of Conservation of KE and Conservation of momentum.

(9) "C" Collision is basically elastic, Large ball does not really move so beach ball Bounces back with slightly less speed than it originally had when started.

(10) Elastic Collision



Compare V_2' to V_1

$$V_2' = \frac{2m_1}{m_1+m_2}V_1 - \frac{m_1-m_2}{m_1+m_2}V_2$$

← Drops off due to $V_2 = 0$

$$\therefore V_2' = \frac{2m_1}{m_1+m_2}V_1$$

since m_2 is light, m_1+m_2 is barely larger than m_1. (obvious)

$$\therefore V_2' = 2\left(\frac{m_1}{m_1+m_2}\right)V_1$$

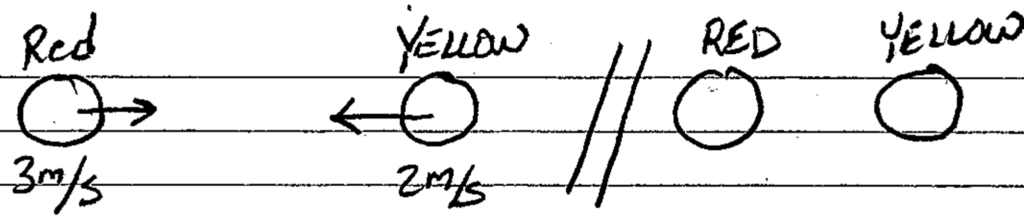
$$V_2' = 2(1)V_1$$

↑ Approximate but just under 1, i.e. about .95 or so

$$\therefore V_2' = 2V_1$$

Light object will move about double the First objects velocity.

(11) "B"



PROBLEM DOES NOT SAY, SO ASSUME ELASTIC AND SINCE THEY HAVE SAME MASS THEY SWITCH VELOCITIES. [IF mass Different Solve as Below]

(OR)

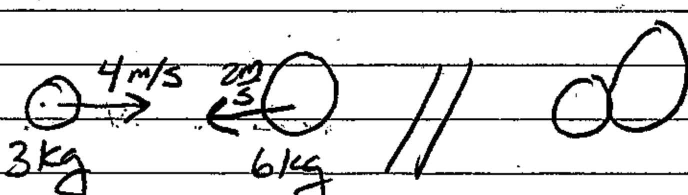
$$V_2' = \frac{2m_1}{m_1+m_2}V_1 - \frac{m_1-m_2}{m_1+m_2}V_2$$

$$V_1' = \frac{m_1-m_2}{m_1+m_2}V_1 + \frac{2m_2}{m_1+m_2}V_2$$

(12) "C" Look up Description of INelastic Collisions

(13) "B" SAME AS #12

(14) "D"



BEFORE = After

$$m_1V_1 + m_2V_2 = (m_1+m_2)V'$$

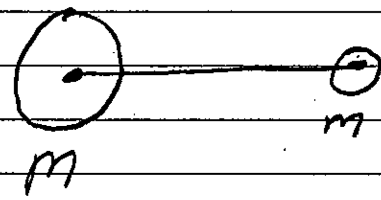
$$3(4) + 6(-2) = (3+6)V'$$

$$0 = 9V'$$

$$V' = 0\ m/s$$

∴ NO KE

(15) "D"



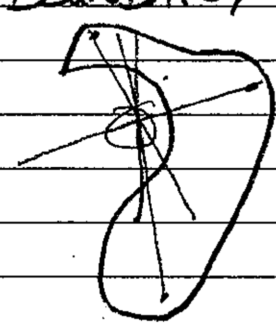
- The center of mass is closer to the larger mass and may even be within the radius of the larger object.

- If a uniform bar is placed between the two masses, it has a center of mass and will move the overall center of mass away from the larger object

$$X_{cm} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3}{m_1 + m_2 + m_3}$$

~~Adding another~~ object, increases the numerator more than denominator changing the C.O.M.

(16) "C" USE AN ODD SHAPED BOARD, AS SEEN BELOW. THE C.O.M MAY FALL OUTSIDE THE OBJECTS BOUNDARY

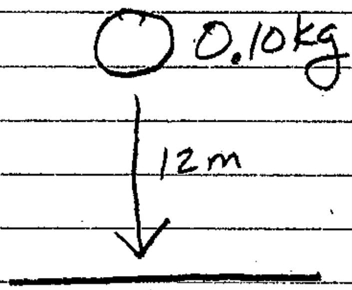


(17.) "C"

Really they carry a long Rod For several reasons

#1. can be used to Lower their C.O.M
#2. Allow Them to adjust COM so it STAYS Above wire they are walking ON.
* #3. Added inertia - Rotational
* #4. Torque Equilibrium → (YET TO BE Covered)

(18) "A"



Find Velocity just Before it hits the FLOOR.

$V_f^2 = V_0^2 + 2aS$

$V_f^2 = 0^2 + 2(9.8\frac{m}{s^2})(12m)$

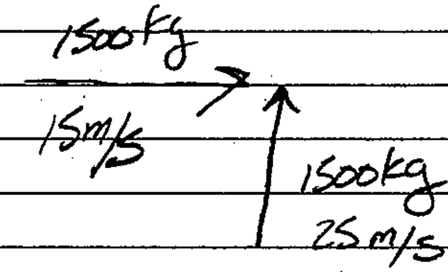
$V_f = 15.34 m/s$

$P = 0.10kg(15.34 m/s)$

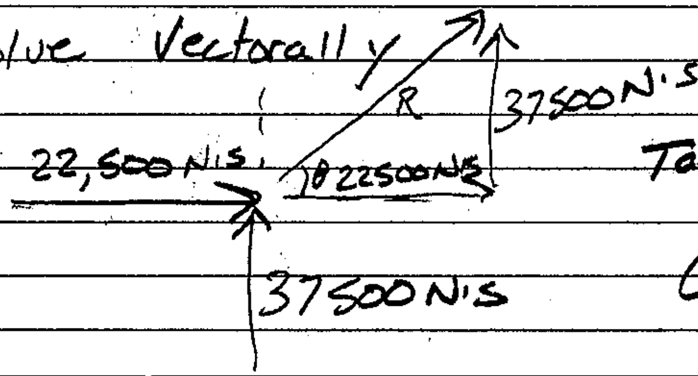
$P = 1.5 N \cdot s$

$P = 1.5 kg \cdot m/s$

(19) "B"



Solve Vectorally



$\tan\theta = \frac{37500}{22500}$

$\theta = 59^\circ$

USE PYTHAGOREAN'S THEOREM

R = 43732 N·s @ 59° N of E

(20) "A"

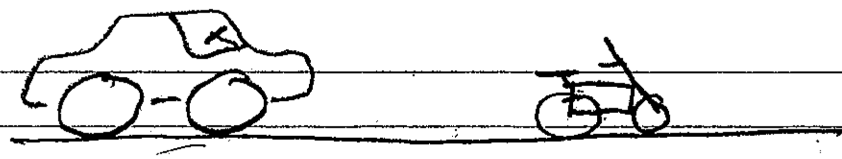
ACTION / REACTION

$m_1 V_1 = m_2 V_2$

$70\,kg\, V_1 = 2\,kg \cdot 14\,m/s$

$V_1 = 0.4\,m/s$

21 "B"



1000 kg 200 kg
6 m/s 0 m/s

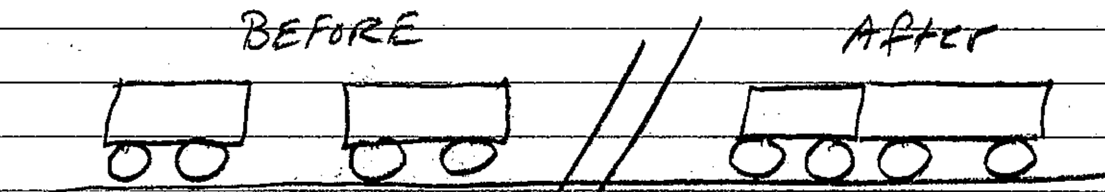
Momentum Before = momentum After

$m_1 v_1 + m_2 v_2 =$

$1000(6) + 200(0) =$

6000 N·s = momentum After

22 "A"



$m_1 v_1 + m_2 v_2 = (m_1 + m_2) V'$

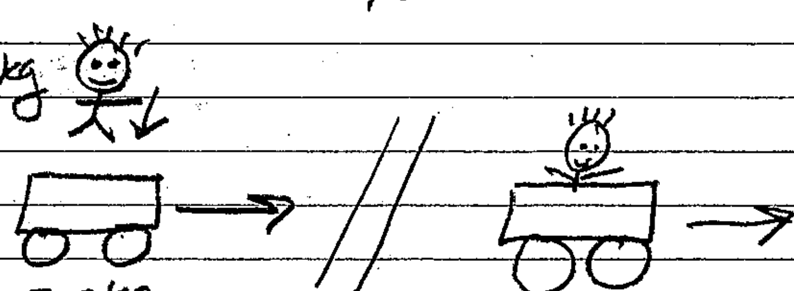
$15{,}000(2) + 50{,}000(0) = 65{,}000\ V'$

$30{,}000 = 65{,}000\ V'$

$0.462\ m/s = V'$

23 "C"

70 kg



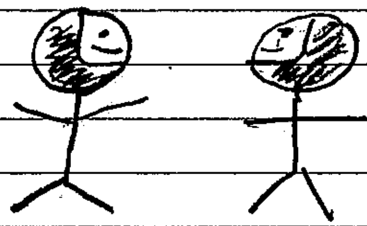
200 kg
10 m/s

$m_1 v_1 + m_2 v_2 = (m_1 + m_2) V'$

$70(0) + 200(10) = 270\ V'$

$7.41\ m/s = V'$

(24) "C"



60kg 80kg

Action / Reaction

$$m_1 V_1 = m_2 V_2$$

$$m_1 \frac{d_1}{t_1} = m_2 \frac{d_2}{t_1}$$

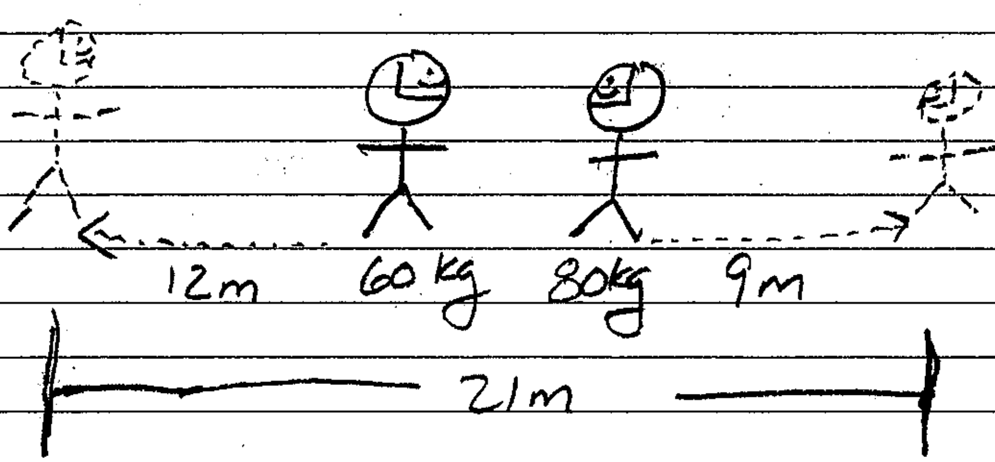
Notice time Is the same for Both!!

∴ time Cancels

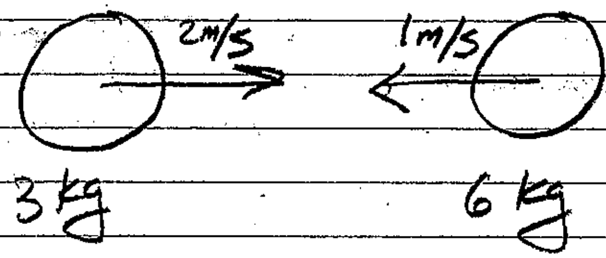
$$\therefore m_1 d_1 = m_2 d_2$$

$$60\text{kg}(12\text{m}) = 80\text{kg}\, d_2$$

$$9\text{m} = d_2$$



25 "A"



$$KE_{Before} = KE_{After} \quad (\text{Elastic})$$

$$\tfrac{1}{2} m_1 V_1^2 + \tfrac{1}{2} m_2 V_2^2 = KE_{After}$$

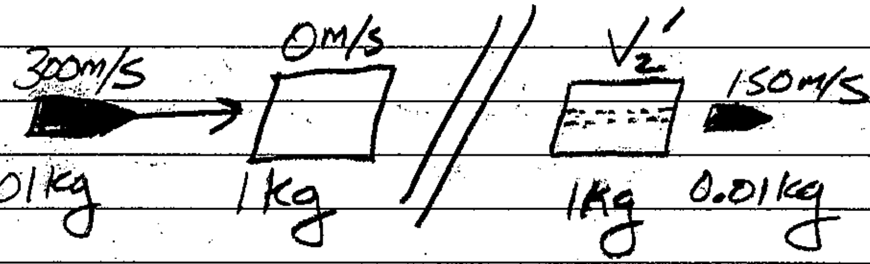
$$\tfrac{1}{2}(3\,kg)(2\,m/s)^2 + \tfrac{1}{2}(6\,kg)(1\,m/s)^2 = KE_{AFTER}$$

$$6\,J + 3\,J = KE_{After}$$

$$9\,J = KE$$

YES, MANY students get 3J Because they make ONE of the velocities Negative BUT the Question Asks FOR Total KE NOT NET! Very Important.

(26) "A"



$$m_1V_1 + m_2V_2 = m_2V_2' + m_1V_1'$$

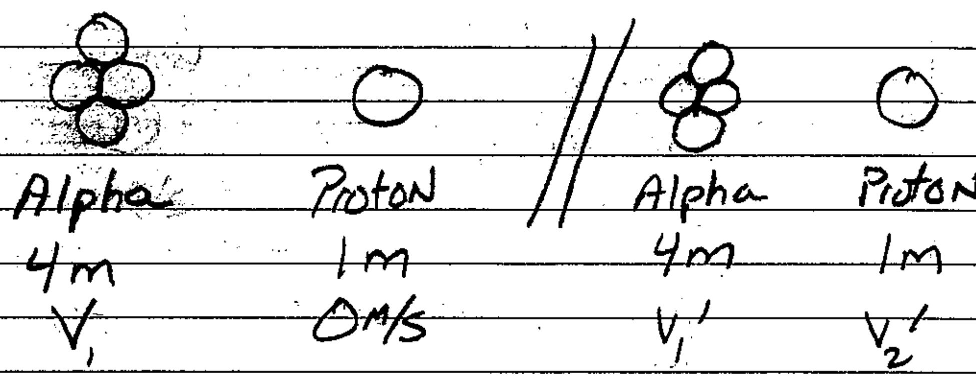
$$(0.01kg)(300) + 1kg(0) = 1kg\,V_2' + (0.01kg)(150)$$

$$3 + 0 = 1kg\,V_2' + 1.5$$

$$3 - 1.5 = 1kg\,V_2'$$

$$1.5\frac{m}{s} = V_2'$$

(27) "C"



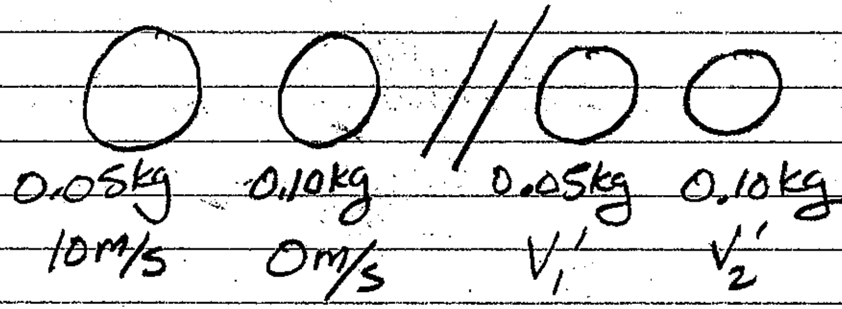
$$V_1' = \frac{m_1 - m_2}{m_1 + m_2}V_1 + \frac{2m_2}{m_1 + m_2}V_2$$

$$V_1' = \frac{4m - 1m}{4m + 1m}V_1 + 0$$

$$V_1' = \frac{3m}{5m}V_1$$

$$V_1' = \frac{3}{5}V_1$$

(28) "A"



solve for V_1' & V_2'

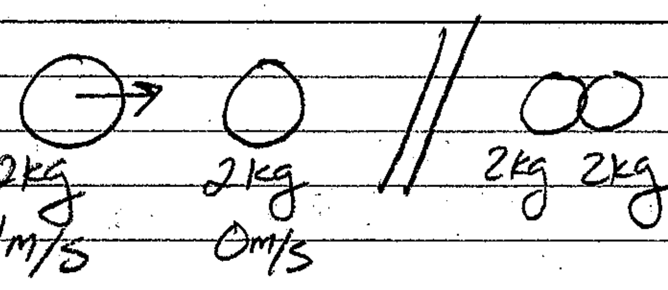
$$V_1' = \frac{m_1 - m_2}{m_1 + m_2} V_1 + \frac{2m_2}{m_1 + m_2} V_2 \qquad V_2' = \frac{2m_1}{m_1 + m_2} V_1 - \frac{m_1 - m_2}{m_1 + m_2} V_2$$

$$V_1' = \frac{.05 - .1}{.05 + .1} 10\,m/s + 0 \qquad V_2' = \frac{2(.05)}{.05 + .1} 10 - 0$$

$$V_1' = \frac{-0.05}{.15} 10\,m/s \qquad V_2' = \frac{.1}{.15} 10$$

$$V_1' = -3.33\,m/s \qquad V_2' = 6.67\,m/s$$

(29) "C"



$$m_1 V_1 + m_2 V_2 = (m_1 + m_2) V'$$
$$2(4) + 2(0) = (2+2) V'$$
$$8 = 4V'$$
$$2\,m/s = V'$$

KE Before = KE After

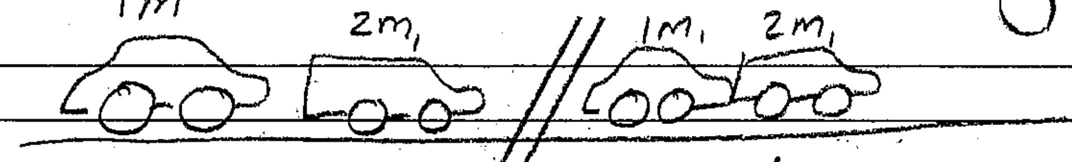
$\frac{1}{2} m v_1^2 + \frac{1}{2} m v_2^2 \neq \frac{1}{2} m v'^2$

16 J + 0 J ≠ 8J

(Lost 8J)

30

"D"



$1m_1 V_1 + 0 = 3m_1 V'$

$1m_1 V_1 = 3m_1 V'$

$\boxed{V_1 = 3V'}$

THIS means CAR is going 3X faster than two stuck together.

NOW Compare KE BEFORE & After

KE (BEfore) | KE (After)

$\frac{1}{2} m_1 V_1^2$ | $\frac{1}{2} m V'^2$

Find common Velocity
TO Compare

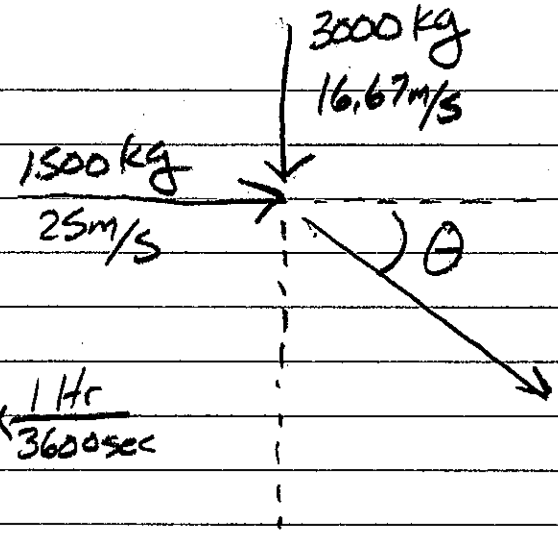
$\frac{1}{2} m_1 (3V')^2$ | $\frac{1}{2} 3m (V')^2$

$\frac{1}{2} m_1 9V'^2$ | $\frac{1}{2} 3m V'^2$

LEFT SIDE IS 3X MORE THAN Right SIDE (AFTER) OR ONLY $\frac{1}{3}$ Left $\therefore$ LOST $\frac{2}{3}$!!

(31) "B"

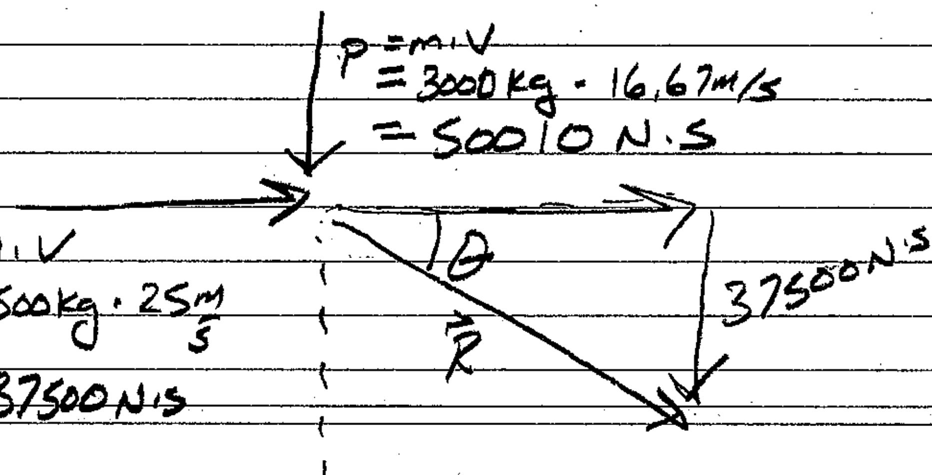
$60\frac{km}{Hr} \times \frac{1000m}{1km} \times \frac{1Hr}{3600sec} = 16.67 m/s$



$90\frac{km}{Hr} \times \frac{1000m}{1km} \times \frac{1Hr}{3600sec}$

$= 25 m/s$

Solve Momentum for each Car



$p = m \cdot V$
$= 3000 kg \cdot 16.67 m/s$
$= 50010 N \cdot S$

$p = m \cdot V$
$= 1500 kg \cdot 25 \frac{m}{s}$
$= 37500 N \cdot S$

Solve $\vec{R}$ with Pythagorean Theorum

$\vec{R} = 62508 N \cdot S$

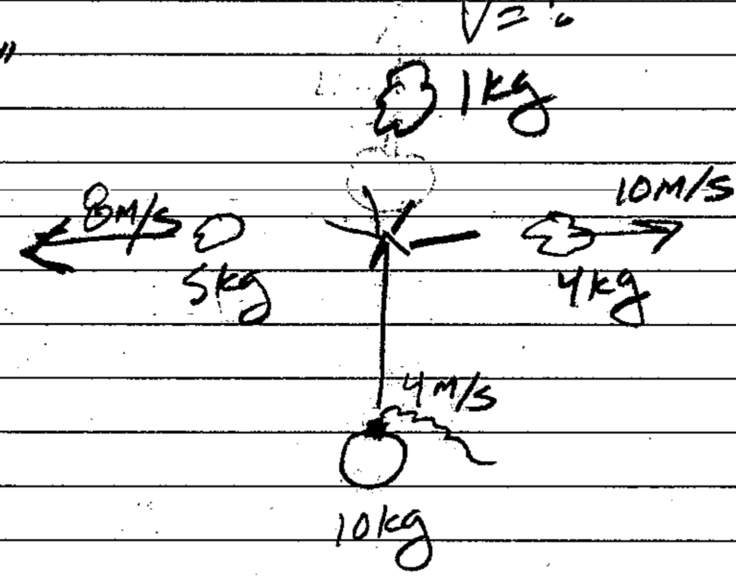
$P = m \cdot V$
$62508 N \cdot S = 4500 kg \cdot V$
$13.89 m/s = V$

(32) "C"

$$\tan\theta = \frac{37{,}500\,N \cdot s}{50{,}010\,N \cdot s}$$

$\theta = 36.86°$ S of E

(33) "B"

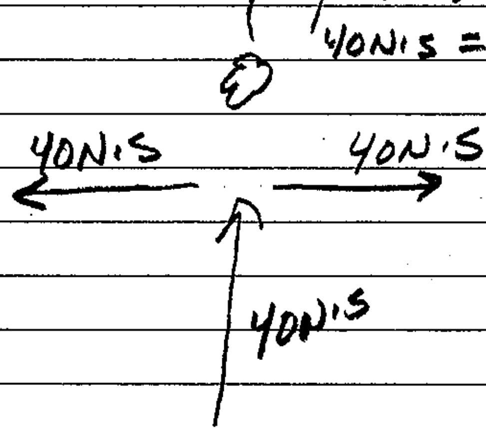


Remember momentum x & y axis is conserved.

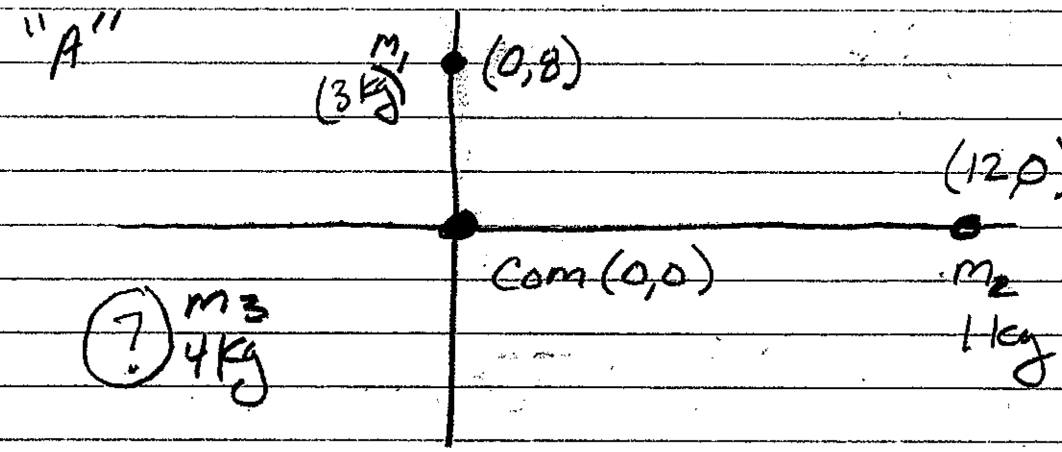
$p = m \cdot V$

$40\,N \cdot s = 1\,kg\,V$

$V = 40\,M/S$ North



(34) Draw the Situation



USE CENTER of mass Formula to Solve for m_3 "x" + "y" Values.

$$X_{cm} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3} \qquad Y_{cm} = \frac{m_1y_1 + m_2y_2 + m_3y_3}{m_1 + m_2 + m_3}$$

$$X_{cm} = \frac{3kg(0) + 1kg(12) + 4kg\,x_3}{3+1+4} \qquad Y_{cm} = \frac{3kg(8) + 1kg(0) + 4(y_3)}{3+1+4}$$

$$0 = \frac{12 + 4x_3}{8} \qquad 0 = \frac{24 + 4y_3}{8}$$

$$0 = 12 + 4x_3 \qquad 0 = 24 + 4y_3$$

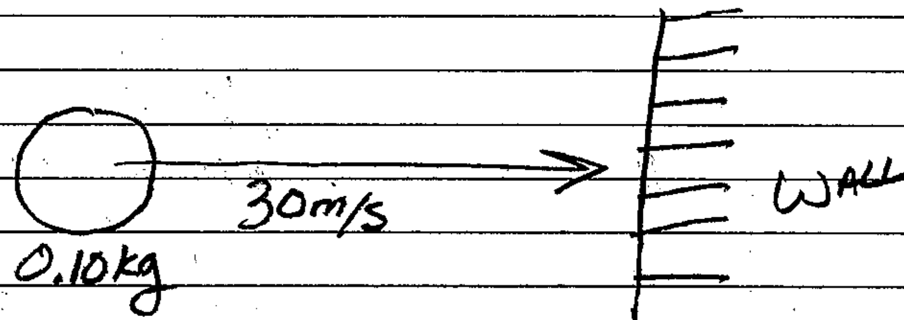
$$-12 = 4x_3 \qquad -24 = 4y_3$$

$$-3 = x_3 \qquad -6 = y_3$$

$$(-3, -6)$$

35

"C"

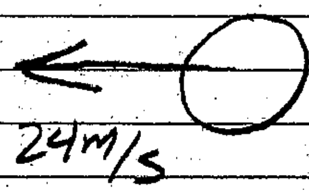


30m/s to 0m/s

$\Delta P = m \cdot \Delta V$

$\Delta P = .1kg(30m/s)$

$\Delta P = 3N \cdot s$



0m/s to 24m/s

$\Delta P = m \cdot \Delta V$

$\Delta P = .1kg(24m/s)$

$\Delta P = 2.4N \cdot s$

Total Change $= 3N \cdot s + 2.4N \cdot s$

$= 5.4N \cdot s$